DOE F 1325.8
(8-89)
EFG (07-90)

United States Government **Department of Energy**

Memorandum

DATE: July 15, 2008

REPLY TO ATTN OF: EM-63 (Dr. James M. Shuler, 301-903-5513)

SUBJECT: Approval of Product Deviation Request Number 275 (PDR No. 275), Issue E

TO: Gilbert Torres, Facility Operations Director for Packaging and Transportation, Los Alamos National Laboratory

Los Alamos National Laboratory (LANL), the certificate holder for the SAFESHIELD 2999A submitted a request for approval of product deviation (PDR No. 275) dated November 14, 2007, LANL Letter P&T: 07-093. The SAFESHIELD 2999A is a Type B transportation packaging approved by the DOE Certificate of Compliance USA/9519/ B(U)-96 (DOE), Revision 0, October 12, 2005, which is based on the SAFESHIELD SARP 2999A, Revision 4, July 4, 2005. The staff of the Packaging Certification Program (PCP) reviewed the original PDR and issued six questions on December 21, 2007 regarding the two options mentioned in the PDR. Your letter (P&T: 08-025, April 3, 2008) provided responses to the six questions and noted that LANL has made the decision not to pursue Option 1; therefore, the Product Deviation Request, PDR No. 275 has been altered to reduce the scope of this request.

The PCP staff has evaluated the responses to the questions and Option 2 in the reduced-scope PDR. The evaluation is summarized below:

The Croft Associates Report No. CTR 2008/01, Issue E, March 18, 2008, *SAFESHIELD 2999A PDR 275 Cavity liner manufacturing change justification* provides the cause for the deviation, the proposed change, and the engineering justification for design and manufacturing changes. In the manufacture of the first production unit of SAFESHIELD 2999A a distortion occurred at the weld joining the Top Flange to the Cavity Liner. The distortion was bulging within the cavity that produced a ring of reduced diameter at the weld and a depression on the outside of the cavity liner extending axially on both sides of the weld. Measurements confirmed that the internal diameter could be machined to meet the current design. However, the depression on the outside diameter was greater than 1 mm allowance and the cavity assembly would be nonconforming by having a local wall thickness of approximately 1.5 mm less than the specified nominal thickness of 5mm. Following a design review and a review with the manufacturing contractor, two options were assessed. The first option was a revised welding plan using thicker parts which would provide more machining allowance. This plan was designated as Option 1. The second option was to machine a one piece Cavity Liner from a solid billet. The one piece Cavity Liner would be identical to the prototype Cavity Assembly (Cavity Liner plus Top Flange). This plan was designated as Option 2.

The certificate holder states that Option 2 utilizes the same material as the material described in the SARP. The certificate holder states that the dimensions of the one piece Cavity Liner when utilizing Option 2 are the same as the dimensions of the original Cavity assembly described in the SARP. Product Deviation Request (PDR No. 275) represents a change in the method of manufacture only. A new drawing (1C-5815, Revision A) for the one piece Cavity Liner in Option 2 has been submitted with the PDR. For Option 2 the one piece Cavity Liner will be rough machined from the billet. After rough machining the one piece the Cavity Liner will be annealed. The certificate holder states that the annealing will be done to the same requirements as currently specified in the SARP. Following annealing the one piece Cavity Liner will be final machined. This sequence is the same as for the prototype discussed in the SARP.

Prior to beginning work on the billet, the certificate holder states that a slice will be taken from each end of the billet and checked for piping (axial cracking) by helium leak testing. This is done to reduce manufacturing risk and increase confidence that the finished component will not have an axial leak. This is a prudent practice, but not a requirement. The finished machined, one-piece Cavity Liner will be helium leakage tested in accordance with CP 200 as discussed on page 8-4 of the SARP.

The PCP staff evaluated the PDR to determine whether the proposed manufacturing change of the cavity liner would affect the results of the tests that were conducted on a prototype SAFESHIELD to support the original design certification. The staff determined that the cavity liner has the same final dimensions, material, and heat treatment as the prototype packaging except that it does not contain welding. The cavity liner made from a solid billet should meet, or exceed the performance requirements of the tested prototype including its performance during drop tests.

Option 2 described in Report No. CTR 2008/01, Issue E, March 18, 2008, for PDR No. 275 that involves machining the Cavity Liner from a solid billet is thereby approved. A copy of this Memorandum and the PDR No. 275, Issue E, March 18, 2008, will be place on the RAMPAC data base on the Certificate Retrieval Page under the DOE Certificate of Compliance USA/9519/B(U)-96 (DOE).

If you have any questions, please call Dr. James M. Shuler at (301) 903-5513.

Sincerely,

Dae Y. Chung
Headquarters Certifying Official
Deputy Assistant Secretary for
Safety Management and Operations
Office of Environmental Management

cc:
James Shuler, EM-63
Yung Liu, ANL
David McCollum, LANL
Luisa Romero, NE-34
John Pantaleo, NE-34

SAFESHIELD 2999A
PDR 275 - Cavity liner manufacturing change justification

Title	SAFESHIELD 2999A PDR 275 - Cavity liner manufacturing change justification	**Number** **Issue** **File Reference**	CTR 2008/01 Issue E CTR2008-01-E-v1-2999A-PDR275.wpd
Compiled	R A Vaughan	**Checked**	I Dingwall
Approved	R P Hows	**Date**	18 March 2008

Croft Associates Ltd F4 Culham Science Centre Abingdon Oxon OX14 3DB UK Tel 44 (0)1865 407740

SAFESHIELD 2999A - PDR 275
Cavity liner manufacturing change justification

1 Summary

In the manufacture of the first production unit of SAFESHIELD 2999A a distortion occurred at the weld of the Top Flange to the Cavity Liner. The distortion was bulging within the cavity (producing a ring of reduced diameter at the weld) and a depression on the outside of the cavity liner extending axially, on both sides of the weld. Although measurements confirmed that the internal diameter could be machined to meet the design, the depth of the hollow on the outside diameter was greater that the 1 mm machining allowance and therefore the Cavity Assembly would be nonconforming by having a local wall thickness of approximately 1.5 mm less than the specified nominal thickness of 5 mm.

Following a design review and a review with the manufacturing contractor, it has been concluded that the problem in producing the Cavity Assembly can best be avoided by either increasing the machining allowance (welding together thicker parts) on the original piece and final machine to the original design dimensions (this is designated Option 1 - Welded CV), or by machining the Cavity Assembly from a single solid billet in the same way that the Top Flange and the Cavity Liner are machined from two solid billets (this is designated Option 2 - Machined CV).

After consideration of the merits and demerits of Options 1 and 2, it has been concluded that it is preferable to not pursue Option 1 - Welded CV and to adopt Option 2 - Machined CV only. However, the welded option in the SARP is to be retained as an approved method of manufacture as this may be usable with suitable weld trials.

This report details the reason for the change (deviation from approved design), and gives details of the proposed change in manufacturing method including changes to the drawings. This report also gives the engineering justification for the proposed change and additional information on manufacturing details for Option 2 - Machined CV.

The SAFESHIELD 2999A is approved by DOE certificate USA,9519/B(U)-96 (DOE) Rev 0 which is based upon LANL SARP 2999A, Rev 4 which includes the drawings and other specifying documents. This report (CTR 2008/01) is prepared for approval of the changes by DOE and for adding to the SARP at next issue as a record of the change in the drawings.

2 PDR 275 - Cavity Liner Method of Manufacture

The relevant information in the PDR 275 is given below. The referenced drawings are given in Appendix A.

2.1 Reason for Deviation

The design for the 2993 flask (see 2999A package specification DL-1C-4540 Issue E) specifies that the flask Top Flange (drg 2C-4500 Issue D) is welded to the Cavity Liner (drg 2C-4499 Issue D) - both having a wall thickness of 7mm in the area of the weld. After

welding, the wall thickness is machined both externally and internally to a final dimension of 5mm, in accordance with Cavity Assembly drawing 2C-4492 Issue D.

In attempting to produce this weld on the production unit, the Cavity Liner and Top Flange were significantly distorted, producing a bulging on the cavity (producing a ring of reduced diameter at the weld) and a depression on the outside extending axially away from the weld. Measurements confirmed that although the internal diameter could be machined to meet the design specification, the depth of the hollow on the external surface of the Cavity Liner was greater than the 1mm machining allowance and therefore the finished Cavity Assembly would be non-conforming by having a local wall thickness of approximately 1.5mm less than specification – see Figure 1 below (note that this photograph shows the CV before final machining).

Figure 1 - Cavity Assembly after welding showing hollow caused by weld distortion

Croft Associates and the welding sub-contractor consider that further welding would only increase the distortion and therefore a decision has been made to reject this Cavity Assembly and this method of producing this component.

2.2 Proposed Deviation

It has been concluded that the above problem in producing the Cavity Assembly can best be avoided by either increasing the machining allowance (welding together thicker parts and final machining as originally specified to the design dimensions), or by machining the Cavity Assemble from a solid billet. It is proposed that only the second option be made to the design specification as an approved change; the justification for this change being approved is that there is no change in the materials or dimensions of the Cavity Assembly – only a change in the method of manufacture.

Improvements in machining and production techniques since the original design and prototype fabrication in 1995, means that machining from solid forged bar stock is now a practical and reasonably cost effective option.

2.3 Detailed drawing changes for Option 2 - Machined CV

The design drawings are to be amended to specify manufacture of the Cavity Liner by machining the complete liner from solid forged bar stock. The finished dimensions are to be as currently specified on the drawings in the SARP. The machined from solid Cavity Liner is specified on new drawing 1C-5815 issue A. The drawing also includes the removal of the 8 Slot Drilled holes, as in Option 1 welded CV, as these are not required for the revised manufacturing method.

3 Engineering Justification

The principle engineering justification for the proposed manufacturing changes (and related drawing changes) is that there is no change in the materials or dimensions of the Cavity Assembly: that is, the finished dimensions and material properties are the same as for the approved design.

The Option 2 - Machined CV wall thickness is specified as 5mm and this full thickness is guaranteed by machining from solid. As the machined from solid wall at the position of the weld is to the same specification as that of the prototype, it is concluded that the Option 2 Machined CV would perform equally well to that of the prototype.

For the Option 2 - Machined CV, no new techniques are involved in the change: the Cavity Assembly is machined from a single solid billet in the same way that the Top Flange and the Cavity Liner are machined from two solid billets.

For Option 2 - Machined CV, the Cavity Liner is machined from a solid billet; the material and procedures such as leak testing the ends of the billet and annealing (stress relieving), are the same as specified and carried out on the prototype.

For the prototype package, the cavity liner was made in two parts (cavity liner and top flange), each machined from a solid billet. The billet for the cavity liner was rough machined and then annealed prior to final machining.

For the production package under Option 2 - Machined CV, annealing is to be undertaken after rough machining the billet and before final machining; as was carried out on the prototype on the 2 cavity liner parts prior to welding. The specification for the annealing is given in drawing 1C-5815 issue A as 1,050^{o}C for 1 hour. The annealing specification is exactly the same as for the prototype Cavity Liner and the Cavity Liner specified in the SARP.

The billet for machining the CV components is checked for piping by helium leak testing of a slice from each end. This is to reduce manufacturing risk and save costs by ensuring that a finished component would not have a leak on its axis: this is common practice but is not

specified in the SARP.

The key issue in concluding that the Option 2 - Machined CV would perform equally well to that of the prototype package is that there is no change in the materials or dimensions of the Cavity Assembly, only a change in manufacturing details which guarantee a better liner; the liner being”better” in that it has no weld, which could be regarded as a potential area of weakness.

It is concluded that a flask fabricated with a cavity liner machined from a solid billet meets or exceeds the performance characteristics of the tested prototype.

On reviewing the package design and in particular the design of the flask and the containment vessel (cavity liner, top flange and lid) and the test evidence, it is clear that the cavity liner is not a highly stressed component - the region of the weld is buried within the lead shielding and protected by both the lead and the outer skin of the flask as well as the outer casket of the package. This supports the conclusion that a flask fabricated with a cavity liner machined from a solid billet meets or exceeds the performance characteristics required by the regulations, and as demonstrated to be met by the prototype and reported in the SARP.

~~~~~~~~~~~~~~~ o ~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~

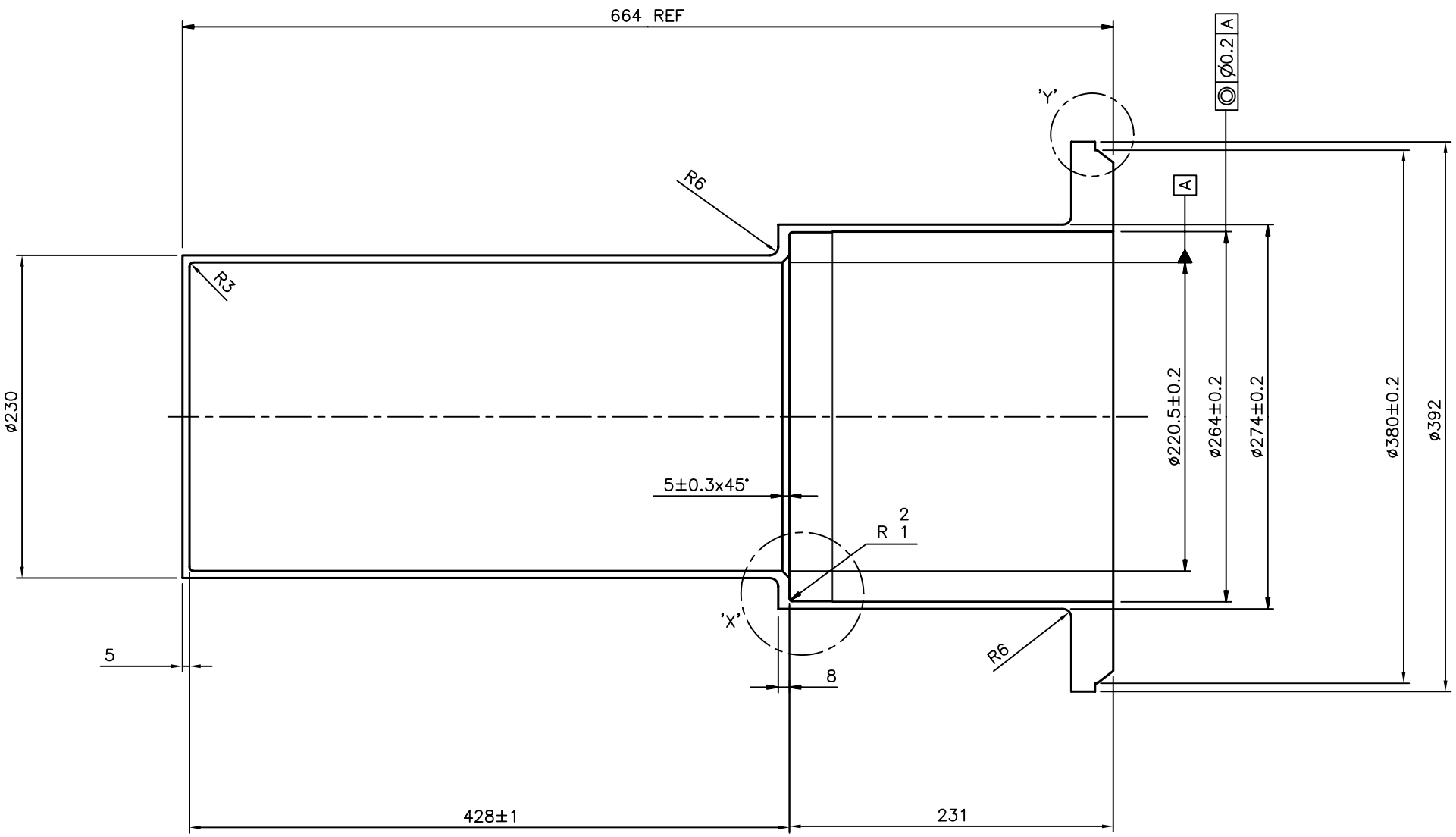
Appendix A - Drawings referenced in this memo

This appendix includes the drawings referenced in this memo that are associated with the change in specification: drawings referenced but not changed are not listed and not included in this appendix (they are in the SARP Rev 4).

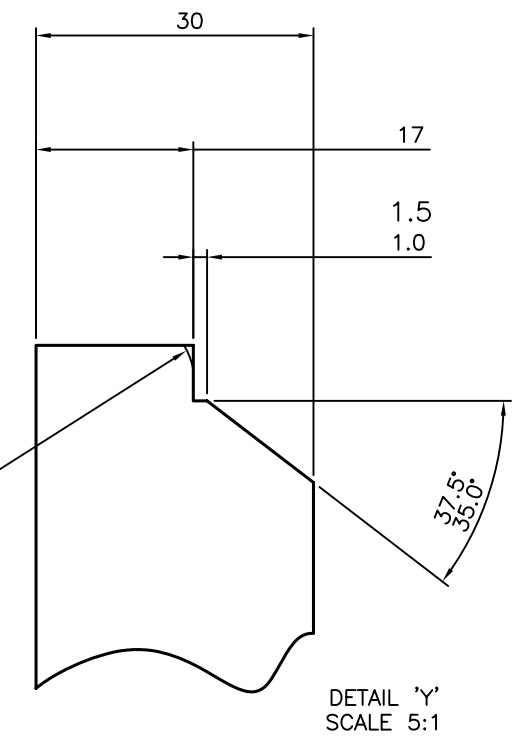
Document #	Issue	Title	Comments
1C-5815	A	Cavity Liner	Machined from solid

Drg. No. 1C–5815	Third Angle Projection	This drawing is the private and confidential property of CROFT ASSOCIATES and must not be loaned, copied or reproduced without written permission.

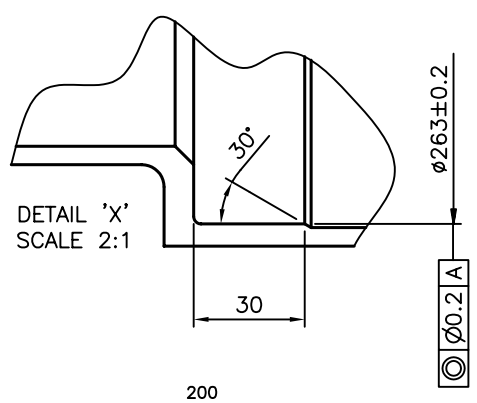
DO NOT SCALE – IF IN DOUBT ASK



REF. WELD W10 DRG 0C–4493
HAND GRIND OR MACHINE CORNER IF REQUIRED TO ENSURE CORRECT ALIGNMENT OF WELD PREPS (MUST MATCH WITH TOP CONE DRG 2C–4506)



DETAIL 'Y'
SCALE 5:1



DETAIL 'X'
SCALE 2:1

0 200

NOTES

1 MATERIAL EXAMINATION – THE STOCK MATERIAL FOR THIS ITEM IS TO BE LIQUID PENETRANT TESTED IN ACCORDANCE WITH ASME III SUBSECTION NB 2546 AND ULTRASONICALLY EXAMINED USING THE STRAIGHT BEAM UT METHOD IN ACCORDANCE WITH ASME III SUBSECTION NB 2532.1

2 INTEGRITY TESTING – THE STOCK MATERIAL FOR THIS COMPONENT IS TO BE CHECKED BY LEAKAGE TESTING SAMPLE DISCS CUT FROM EACH END OF THE STOCK BILLET. FULL DIA OF SAMPLE DISCS TO BE TESTED

MAX PERMISSIBLE LEAKAGE RATE $5x10^{-8}$ mbar.l/s HELIUM

3 COMPONENT TO BE VACUUM FURNACE STRESS RELIEVED AT 1050°C FOR ONE HOUR PRIOR TO FINAL MACHINING.

4 FINISHED MACHINED COMPONENT TO BE HELIUM LEAKAGE TESTED IN ACCORDANCE WITH CP 200

Material & Spec. STAIN.S ASTM A479/A479M–04, 304L SEE NOTES 1 & 2	Dims.in mm	Surface Texture Unless Stock 1.6	CROFT	Title CAVITY LINER (MACHINED FROM SOLID)	Issue A / Date 12/10/07 / Mod.No. –
Finish CLEAN	Tolerances ±0.5 ANG ±1° Unless Stated	Drawn I DINGWALL			
	Original Scale 1:2	Checked S DONALD			
		Approved R VAUGHAN		Job No.	Drg. No. 1C–5815